# Engineering Design Process

THE DESIGN PROCESS

The five steps used for solving design problems are:

1. Define the problem
2. Gather pertinent information
3. Generate multiple solutions
4. Analyze and select a solution
5. Test and implement the solution

Define the Problem

Gather Information

Engineering Design Process

Generate multiple solutions

Analyze and select a solution

Test and Implement solution
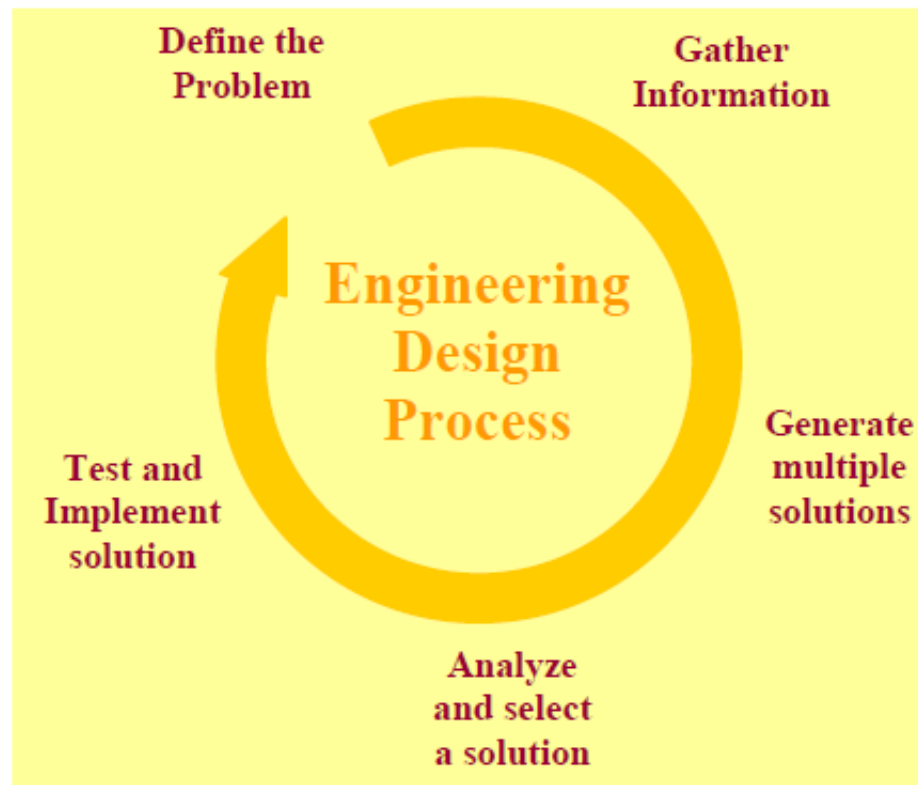
1. DEFINE THE PROBLEM

You need to begin the solution to a design problem with a clear, unambiguous definition of the problem. Unlike an analysis problem, a design problem often begins as a vague, abstract idea in the mind of the designer. Creating a clear definition of a design problem is more difficult than, defining an analysis problem. The definition of a design problem may evolve through a series of steps or processes as you develop a more complete understanding of the problem.

2. GATHER PERTINENT INFORMATION

Before you can go further in the design process, you need to collect all the information available that relates to the problem. Novice designers will quickly skip over this step and proceed to the generation of alternative solutions. You will find, however, that effort spent searching for information about your problem will pay big dividends later in the design process. Gathering pertinent information can reveal facts about the problem that result in a redefinition of the problem. You may discover mistakes and false starts made by other designers. Information gathering for most design problems begins with asking the following questions. If the problem addresses a need that is new, then there are no existing solutions to the problems, so obviously some of the questions would not be asked.

- Is the problem real and its statement accurate?
- Is there really a need for a new solution or has the problem already been solved?
- What are the existing solutions to the problem?
- What is wrong with the way the problem is currently being solved?
- What is right about the way the problem is currently being solved?
- What companies manufacture the existing solution to the problem?
- What are the economic factors governing the solution?
- How much will people pay for a solution to the problem?
- What other factors are important to the problem solution (such as safety, aesthetics and environmental issues)?

3. GENERATE MULTIPLE SOLUTIONS

The next step in the design process begins with creativity in generating new ideas that may solve the problem. Creativity is much more than just a systematic application of rules and theory to solve a technical problem.

Everybody has the potential to be creative. Creativity begins with a decision to take risks. Listed below are a few characteristics of creative people. These are not rigid rules to be followed to experience creativity. You can improve your creative ability by choosing to develop these characteristics in yourself.

Solutions to engineering design problems do not magically appear. Ideas are generated when people are free to take risks and make mistakes. Brainstorming at this stage is often a team effort in which people from different disciplines are involved in generating multiple solutions to the problem.

4. ANALYZE AND SELECT A SOLUTION

Once you've conceived alternative solutions to your design problem, you need to analyze those solutions and then decide which solution is best suited for implementation. Analysis is the evaluation of the proposed designs. You apply your technical knowledge to the proposed solutions and use the results to decide which solution to carry out. You will cover design analysis in more depth when you get into upper-level engineering courses.

At this step in the design process, you must consider the results of your design analysis. This is a highly subjective step and should be made by a group of experienced people. This section introduces a systematic methodology you can use to evaluate alternative designs and assist in making a decision.

5. TEST AND IMPLEMENT THE SOLUTION

The final phase of the design process is implementation, which refers to the testing, construction, and manufacturing of the solution to the design problem. You must consider several methods of implementation, such as prototyping and concurrent engineering, as well as distinct activities that occur during implementation, such as documenting the design solution and applying for patents.

10 Stages Of the Engineering Design Process

Design (Definition)

- The process of originating and developing a plan for a new object
- Requires research, thought, modeling, interactive adjustment, and re-design

1. Identify the Problem

- Engineers are Problem Solvers
- Understand the scope and the nature of the problem
- Identify the correct issues and background of the problem

2. Define Working Criteria and Goals

- Establish preliminary goals
- Develop working criteria to compare possible solutions
  - Specifications
  - Constraints

3. Research and Gather Data

- Stay consistent with working criteria while researching

- Use resources to help research including: Internet, Library, newspaper, etc.

- Keep info found through all steps of the design process and add to it

4. Brainstorm and Generate Creative Ideas

- Develop as many creative ideas as possible
  - No idea is a bad idea
  - Document all ideas
  - Combine ideas to create new ideas
  - Do not evaluate
- If time permitted, hold a second session to give people time to consider additional options
- Goal: Long list of ideas!

5. Analyze Potential Solutions

- Eliminate duplicate ideas
- Clarify ideas
- Select ideas to analyze in more detail
  - Qualitative analysis
  - Quantitative analysis
  - Democratic analysis

6. Develop and Test Models

- Develop models for the selected solutions
- Types of models: descriptive, functional, mathematical, computer, and scale.
- Test each model against working criteria and goals
- Test for functionality and performance

7. Make the Decision

- Evaluate the results of testing to determine the solution to use
- If none of the solutions are ideal, return to stage 4 or 5
- Once a solution is selected, continue to stage 8

8. Communicate and Specify

- Document the design's specifications and measurements and communicate to all groups
- Communication between groups is especially important in this stage
  - Meetings
  - Presentations
  - Reports
  - Drawings

9. Implement & Commercialize

- Final design revisions
- All groups should agree on the proposed project, including: Management, Technical, Business, and legal support representatives
- Production

10. Post-Implementation Review and Assessment

- Review the product's performance
- Assess the product's strength and weaknesses and document
- Make suggestions for future improvements